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## (54) BASE OIL OF LIGHT LUBRICANT OIL AND ITS PRODUCTION

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain a high-performance base oil of light lubricating oil advantageously usable as a base oil of various kinds of lubricating oils and easily producible from heavy gas oil or vacuum gas oil at a relatively low cost.

SOLUTION: This base oil of light lubricating oil is a hydrocarbon-based oil having the following properties: (1) the boiling point is within the range of 250-430° C under normal pressure, (2) the total aromatic content is  $\leq 1.8\text{wt.}\%$ , (3) the kinetic viscosity is 5-10mm<sup>2</sup>/s at 40° C, (4) the viscosity index is  $\geq 95$ , (5) the pour point is  $\geq -10^\circ$  C and (6) the oxidation stability of the oil incorporated with 0.5wt.% of 2,6-di-t-butyl-p-cresol(DBPC) is  $\geq 340\text{min}$  in terms of RBOT value.

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CLAIMS

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[Claim(s)]

[Claim 1] It is in within the limits whose boiling point in \*\* ordinary pressure it is light lubricating oil base oil of a hydrocarbon system, and is 250-430 degrees C. \*\* The amount of all aromatic series is 1.8 or less % of the weight, and the kinematic viscosity in \*\*40 degree C is in the range of 5-10mm<sup>2</sup> / s. \*\* Light lubricating oil base oil characterized by for a viscosity index being 95 or more, and for \*\* pour point being -10 degrees C or less, and the oxidation stability when adding \*\*2 and 6-JITA challis butyl-p-cresol (DBPC) 0.5% of the weight being 340 minutes or more in a RBOT value.

[Claim 2] Heavy gas oil (HGO) and/or a vacuum gas oil (VGO) are hydrocracked. Distillation separation of the decomposition product concerned is carried out at the fraction (fraction I) whose terminal point of the boiling point is 250-390 degrees C, and the fraction (fraction II) whose boiling range is 250-540 degrees C. Furthermore, distill the fraction I concerned and separation recovery of the fraction (fraction III) whose boiling range is 240-390 degrees C is carried out. Perform dewaxing processing to the mixture of Fraction III or Fraction III, and Fraction II concerned, remove a part for a wax from this fraction, and the obtained fraction which was dewaxed under existence of a hydrogenation catalyst The total pressure of 170-230kg/cm<sup>2</sup> G, the reaction temperature of 220-370 degrees C, The manufacture approach of the light lubricating oil base oil according to claim 1 characterized by carrying out a hydrogen treating on condition that supply liquid-space-velocity (LHSV) 0.2-1.5hr<sup>-1</sup>, and carrying out separation recovery of the fraction which is in within the limits whose boiling point in ordinary pressure is 250-430 degrees C by distillation from this generation oil.

[Claim 3] The manufacture approach of the light lubricating oil base oil according to claim 2 which is what is performed under existence of the catalyst which makes a silica alumina, an alumina, and/or a zeolite support for hydrocracking, and contains a periodic table VIA group's metal and/or a VIII group's metal.

[Claim 4] The manufacture approach of light lubricating oil base oil according to claim 2 or 3 that dewaxing processings are solvent dewaxing and/or hydrogenation dewaxing.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the light lubricating oil base oil advantageously used for various kinds of lubricating oils (\*\*, such as engine oil, an ATF oil, and various hydraulic oil) used for various kinds of industrial machines and equipments, such as automobiles, vessels, or a machine for construction / machining, etc. for the various purpose as base oil used as the principal component, and its manufacture approach.

[0002]

[Description of the Prior Art] In recent years, high-performance-izing of an automobile, an industrial machine, etc. and energy-saving correspondence progress, and improvement in the engine performance of the lubricating oil used for them is called for strongly. The engine performance of a lubricating oil has the large place which depends on the quality of the base oil used as the principal component, i.e., lubricating oil base oil, especially, in the lubricating oils for automobiles (engine oil, an ATF oil, hydraulic oil, etc.), the hydraulic oil of the machinery for construction / machining, etc., it excels in improvement in shear stability, expansion of an application temperature requirement, oxidation, or the stability over heat and light, and, moreover, lubricating oil base oil of the hydrocarbon system of high performance also with few evaporation losses is moderately desired by hypoviscosity.

[0003] In addition, as a cure of expansion of an application temperature requirement, it is desirable to make high the viscosity index of lubricating oil base oil, and let it be a good plan to make especially the improvement or the reservation of stability to oxidation, heat, light, etc. reduce an aromatic series content. From the former, the approach by solvent extraction, i.e., a solvent refining process, was used widely, and if manufacturing the lubricating oil base oil of a hyperviscous characteristic according to this solvent refining process was also performed for many years, it came for manufacture of the lubricating oil base oil of a hydrocarbon system. However, when manufacturing lubricating oil base oil according to such a solvent refining process, generally it is not easy to raise the viscosity index of a lubricating oil fraction greatly. Therefore, the class of a crude oil itself will be limited narrowly, and moreover, even if strict in the extraction condition, since an improvement and control of oxidation stability etc. of other physical properties were also difficult, fully attaining hyperviscous indexation had easily, the trouble of receiving a limit strong against the physical properties and application of a product.

[0004] Then, as a means to manufacture the lubricating oil base oil of a hyperviscous characteristic, the approach of combining a solvent refining process and/or hydrotreating with hydrocracking is proposed, and the attempt which is going to raise hyperviscous indexation and coincidence also as for the stability over heat, oxidation, etc. is comparatively made recently by reducing or controlling a part for aromatic series by solvent refining and/or the hydrogen treating in that case. (Refer to JP,3-223393,A, a 4-36391 official report, a 6-116570 official report, a 6-116571 official report, and a 6-116572 official report) . However, since it is hard to reduce an aromatic series content efficiently in any case, even if satisfied with an approach given in the above-mentioned official report of hyperviscous indexation, there will be a problem that the reservation of stability to oxidation, heat, light, etc. is not easy.

[0005]

[Problem(s) to be Solved by the Invention] When it was made from the above-mentioned viewpoint, and it has a viscosity index high enough, and an aromatic series content is light lubricating oil base oil which was low excellent in stability (heat, light, oxidation, shear stability, etc.) etc. and uses this as base oil, this invention Expansion of an application temperature requirement, improvement in stability and endurance, and the physical properties as a lubricating oil and optimization of the engine performance can be attained easily. For example, the light lubricating oil base oil which can be advantageously used as base oil of various kinds of lubricating oils used for industrial machines and equipments, such as automobiles, a vessel, or a machine for construction / machining, It aims at offering the manufacture approach of light lubricating oil base oil that the light lubricating oil base oil of this high performance can be obtained comparatively easily at low cost from heavy gas oil or a vacuum gas oil.

[0006]

[Means for Solving the Problem] this invention person etc. completes a header and this invention for the approach the light lubricating oil base oil which has specific physical properties and description as a result of research consists of new technique of carrying out a hydrogen treating on condition that specification wholeheartedly as the manufacture approach of becoming the outstanding light lubricating oil base oil with which are satisfied of the above-mentioned purpose, and the light lubricating oil base oil made into the purpose of such high performance being an advantageous approach suitably and practical.

[0007] Namely, this invention is in within the limits whose boiling point in \*\* ordinary pressure it is light lubricating oil base oil of a hydrocarbon system, and is 250-430 degrees C. \*\* The amount of all aromatic series is 1.8 or less % of the weight, and the kinematic viscosity in \*\*40 degree C is in the range of 5-10mm<sup>2</sup> / s. \*\* A viscosity index is 95 or more and \*\* pour point is -10 degrees C or less. \*\* Offer the light lubricating oil base oil characterized by the oxidation stability when adding 2 and 6-JITA challis butyl-p-cresol (DBPC) 0.5% of the weight being 340 minutes or more in a RBOT value.

[0008] moreover, this invention as the suitable manufacture approach of the light lubricating oil base oil of above-mentioned this invention Heavy gas oil (HGO) and/or a vacuum gas oil (VGO) are hydrocracked. Distillation separation of the decomposition product concerned is carried out at the fraction (fraction I) whose terminal point of the boiling point is 250-390 degrees C, and the fraction (fraction II) whose boiling range is 250-540 degrees C. Furthermore, distill the fraction I concerned and separation recovery of the fraction (fraction III) whose boiling range is 240-390 degrees C is carried out. the mixture of Fraction III or Fraction III, and Fraction II concerned being boiled, dewaxing processing being performed, and a part for a wax being removed from this fraction, and the obtained fraction which was dewaxed under existence of a hydrogenation catalyst The total pressure of 170-230kg/cm<sup>2</sup> G, the reaction temperature of 220-370 degrees C, A hydrogen treating is carried out on condition that supply liquid-space-velocity (LHSV) 0.2-1.5hr<sup>-1</sup>, and the approach characterized by carrying out separation recovery of the fraction which is in within the limits whose boiling point in ordinary pressure is 250-430 degrees C by distillation is collectively offered from this generation oil.

[0009]

[Embodiment of the Invention] Below, the gestalt of operation of this invention is explained. First, the light lubricating oil base oil of this invention is explained. although the light lubricating oil base oil of this invention is realizable as a thing of various presentations or description according to the purpose and the manufacture approach -- at least -- the conditions of the aforementioned \*\* - \*\* -- it is important that it is all satisfied.

[0010] That is, it is important for the light lubricating oil base oil of this invention that it is in within the limits whose boiling point in ordinary pressure is 250-430 degrees C, its 290-390 degrees C are desirable, and its 300-380 degrees C are still more desirable. If the boiling point contains the fraction of a high-boiling point remarkably exceeding the low-boiling point of less than 250 degrees C, or 430 degrees C, the basic property as lubricating oil base oil may not be demonstrated enough, for example, an evaporation loss will increase or it will be easy to produce trouble, such as becoming an increase of energy loss by viscous drag size, here.

[0011] Although it is hydrocarbon mixture which is the thing of a hydrocarbon system and generally uses saturated hydrocarbon, such as n-paraffin, a branched paraffin, and a naphthene hydrocarbon, as a principal component, though the light lubricating oil base oil of this invention contains aromatic hydrocarbon, it is important also for the amount of all aromatic series being 1.8 or less % of the weight, and that [ its ] the amount of [ whose ] all aromatic series is 1.2 or less % of the weight especially is desirable. The value for all aromatic series here is measured by the approach of ASTM-D -2549 (following, the same). Thus, by carrying out a total aromatic series content to 1.8 or less % of the weight, the stability over heat, light, oxidation, etc. is fully securable, it is fully stable and the lubricating oil excellent in endurance can be realized easily.

[0012] Moreover, as for the light lubricating oil base oil of this invention, it is also important that the kinematic viscosity in 40 degrees C is in the range of 5-10mm<sup>2</sup> / s, and what is in the range of 6-9mm<sup>2</sup> / s especially is desirable. That is, the light lubricating oil base oil of this invention is characterized by having an above comparatively low kinematic viscosity property, and is hypoviscosity lubricating oil base oil of high performance. Moreover, the light lubricating oil base oil of this invention is important also for a viscosity index being 95 or more, and it is desirable that it is 98 or more especially. Since the viscosity index has the high value or more of 95 in this way, by applying this as base oil of a lubricating oil, the light lubricating oil base oil of this invention can fully expand the application temperature requirement of the lubricating oil, and can attain multi-clade-ization of a lubricating oil suitably. Also in the case of the light lubricating oil base oil of this invention, the additive for improving a viscosity index can also be used, adding to it suitably, but in the case of this invention, since it may be few, an additive has the advantage that the fall (for example, fall of shear stability) of the other physical properties and property which tend to be produced by addition of an additive can be controlled to the minimum. In addition, the light lubricating oil base oil of this invention possesses high shear stability.

[0013] Furthermore, the light lubricating oil base oil of this invention is important also for the pour point being -10.0 degrees C or less, and what is -15.0 degrees C or less especially is desirable. By this, the cold-temperature fluidity of a lubricating oil can be secured and it can fully respond also to the use in a low-temperature environment. Moreover, although the light lubricating oil base oil of this invention has the stability over heat sufficient also by itself, light, oxidation, etc., various kinds of stabilizers, stabilization assistants, etc., such as an oxidation stabilizer, can be added and used for it if needed. As this oxidation stabilizer, although various kinds of well-known things, such as the below-mentioned thing, are usable, it is important for the light lubricating oil base oil of this invention that the oxidation stability when adding 2 and 6-JITA challis butyl-p-cresol (DBPC) 0.5% of the weight is also 340 minutes or more in a RBOT value (in addition, a RBOT value is measured by ASTM-D -2272 in this case). Of course, this does not mean always adding and using DBPC, can show that it is said that oxidation stability high enough is very securable as mentioned above with addition of the oxidation stabilizer of a minute amount, and can add and use the oxidation stabilizer of arbitration at a rate of arbitration if needed.

[0014] If the light lubricating oil base oil of this invention has satisfied the conditions of the above-mentioned \*\* - \*\* at least as mentioned above, although there is especially no limit about general physical properties, descriptions, etc. other than these, what is generally in the range whose aniline point is 95-110 degrees C is desirable, and a thing 150 degrees C or more is desirable about the flash point, and, speaking of a hue, +20 or more things are desirable in for example, a Saybolt color.

[0015] As mentioned above, the light lubricating oil base oil of this invention is excellent in the radical genuine article nature as lubricating oil base oil for preparing the lubricating oil of various kinds of high performance. It has a hyperviscous characteristic especially. Also in itself, the amount of aromatic series few enough Heat, It is hypoviscosity light lubricating oil base oil of the high performance which has the various advantages of fully being able to attain the further improvement in the stability over light, oxidation, etc. It can be used very advantageous as base oil for preparing the optimal lubricating oil for various kinds of applications by responding to the purpose, adjusting and optimizing the physical properties and description of \*\* - \*\*, or selecting and adjusting other physical properties and descriptions suitably within the limits of the above.

[0016] In addition, it respects to the purpose, and various kinds of additives can be used for the light lubricating oil base oil of this invention, mixing or adding to it. That is, although itself of the light lubricating oil base oil of this invention is also usable as a lubricating oil, it is good to use it as a lubricating oil which added various kinds of following additives according to the purpose, and usually suited each application. As an additive, various kinds of things, such as a well-known thing, are usable. For example, phenol systems, such as 2 and 6-JITA chalis butyl-p-cresol, Antioxidants, such as an amine system, a sulfur system, a thiophosphoric acid zinc system, and a phenothiazin system, Molybdenum dithiophosphate, a molybdenum dithio carbamate, molybdenum disulfide, Fluoride carbon, way acid ester, fatty amine, higher alcohol, Friction reduction agents, such as a higher fatty acid, fatty acid ester, and a fatty-acid amide, tricresyl phosphate, Extreme pressure agents, such as triphenyl phosphate and dithiophosphate zinc, petroleum sulfonate, Rust preventives, such as alkylbenzene sulfonate and dinonyl naphthalene sulfonate, Metal deactivators, such as benzotriazol, alkaline-earth-metal sulfonate, Metal system detergent, such as alkali earth metal phenate, an alkaline-earth-metal SARISHI rate, and alkali-metal phosphonate, viscosity index improvers, such as defoaming agents, such as silicone, polymethacrylate, a polyisobutylene, and polystyrene, a pour point depressant, etc. are mentioned, and independent in these -- or two or more sorts can be combined and it can add.

[0017] Next, as the general manufacture approach, although there is no lubricating oil of this invention, it can manufacture especially a limit with suitably and sufficient productivity by the approach of said this invention. Moreover, as for the lubricating oil base oil of this invention, what was manufactured by the approach of this invention is desirable. Hereafter, the approach of this invention which is the suitable manufacture approach of the light lubricating oil base oil of this invention is explained to a detail.

[0018] In the approach of this invention, heavy gas oil (HGO), a vacuum gas oil (VGO), or the mixed oil of the rate of such arbitration is used as stock oil. As this stock oil, the thing from various kinds of crude oils etc. is usable. From this stock oil, target lubricating oil base oil is fundamentally manufactured according to the essential-oil process which becomes order from a hydrocracking process, a distillation process, dewaxing (wax part removal) down stream processing, a hydrogen-treating (dearomatic series) process, and a distillation process, as shown below.

[0019] (Process 1) hydrogenation part \*\* -- as stock oil with which this hydrocracking is presented, fundamentally, although said heavy gas oil (HGO), a vacuum gas oil (VGO), or the mixed oil of the rate of such arbitration is used, optimum dose addition of the recycle oil from a latter process may be carried out suitably, and a reaction may be presented at these if needed.

[0020] Hydrocracking is usually suitably carried out under the terms and conditions shown below. That is, reaction pressure is total pressure and G and 100-190kg/cm<sup>2</sup> of selecting 130-180kg/cm<sup>2</sup> in the range of G are usually suitable for it preferably. the rate of supply hydrogen gas -- 1kl of supply oils -- receiving -- usually -- 500-1500Nm<sup>3</sup> -- desirable -- 800-1200Nm<sup>3</sup> It is good to adjust to the range.

[0021] It is usually suitable for reaction temperature preferably to select [ 340-440-degree C ] in the range of 350-420 degrees C. moreover, liquid space velocity (LHSV) -- supply oil criteria -- it is -- usually -- 0.3-1.5hr<sup>-1</sup> -- what is necessary is just to adjust suitably in the range of 0.5-1.2hr<sup>-1</sup> preferably As a catalyst used for this hydrocracking, a silica alumina, an alumina, and/or a zeolite are made into support, and what supported a periodic table VIA group's metal and/or a VIII group's metal to the support is used. Here, as a periodic table VIA group metal, Cr, Mo, and W can be mentioned and Mo and W are desirable especially. As a periodic table VIII group metal, although Fe, Co, nickel, Rh, Ru, Pd, Os, Ir, and Pt can be mentioned, nickel is usually desirable. Although these metals can also be used by kind independent and it can also be used combining two or more sorts, combination, such as nickel-Mo and nickel-W, is usually suitable.

[0022] In addition, although various kinds of things, such as an X type, Y mold, faujasite, ZSM-5, and mordenite, can be used when using a zeolite, Y mold is used suitably even especially in inside. Moreover, the support of two or more classes may be used suitably, mixing or compounding. For example, in the case of a zeolite, what used the alumina, the silica alumina, etc. as a matrix and fabricated them to this is used suitably. Furthermore, as this catalyst, the



thing containing support component metallurgy group components other than the above is also usable suitably.

[0023] (Process 2) At the process of \*\*\*\*\*, distillation separates the decomposition generation oil obtained by hydrocracking of the above-mentioned process 1 into the fraction (fraction I) whose terminal point of the boiling point is 250-390 degrees C, and the fraction (fraction II) whose boiling range is 250-540 degrees C. The boiling range where Fraction II is desirable is 300-530 degrees C. Subsequently, Fraction I is distilled further and it separates into a fraction lighter than the fraction (fraction III) and Fraction III whose boiling range is 240-390 degrees C. The boiling range where Fraction III is desirable is 270-390 degrees C. In addition, the boiling point of ordinary pressure or ordinary pressure conversion shows each boiling range (following, the same).

[0024] In this way, the mixture (henceforth a light lubricating oil fraction) of separated Fraction III or Fraction III, and Fraction II is sent to the following process 3, and dewaxing processing is presented with it. Here, as for the mixed rate of Fraction III and Fraction II, Fraction III of Fraction II is usually 90 - 10 % of the weight to 10 - 100 % of the weight. In addition, Fraction II may recycle a part at the above-mentioned process 1 if needed. On the other hand, a fraction lighter than the separated fraction II and Fraction III and recovery gas can be used effective in each application. In addition, when using the mixture of Fraction III and Fraction II, it may mix, after performing dewaxing processing of a process 3 separately, and the hydrogen treating of a process 4 may be performed.

[0025] (Process 3) dewaxing \*\*\*\* -- at this process 3, dewaxing processing of the light lubricating oil fraction obtained at the above-mentioned process 2 is carried out, and a part for a wax (a part for a wax) is fully removed. This dewaxing processing is performed with the hydrogenation dewaxing process (b) which hydrogenates using the following solvent dewaxing process (a) or following catalyst by solvent extraction. In addition, if needed, (b) may be combined with (a), and (b) may be suitably, carried out after (a) in that case, or (a) may be conversely performed after (b). However, the following (a) or (b) can usually perform sufficient dewaxing processing.

[0026] (a) MEK usually using a methyl ethyl ketone (MEK) as an extract solvent component although various kinds of well-known solvent dewaxing processes using various kinds of solvents as a solvent dewaxing process of \*\*\*\*\* are applicable -- law is used suitably. Although dewaxing processing by this MEK method can be fundamentally performed according to a conventional method, it is usually suitable to carry out under the following terms and conditions.

[0027] namely, -- as an extract solvent -- from MEK and toluene -- becoming -- MEK -- 30 to 70 capacity % -- desirable -- 35 to 50 capacity % -- it is -- this -- corresponding -- toluene -- 70 to 30 capacity % -- the thing of a presentation of 65 - 50 capacity % is used suitably preferably. In addition, the solvent which carried out optimum dose addition of other solvents other than MEK and toluene suitably may be used if needed.

[0028] As a supply rate of said light lubricating oil fraction with which said extract solvent and dewaxing processing are presented, although there is especially no limit, it is usually suitable 1.0-6.0, and to select in the range of 1.5-4.5, and to carry out extract dewaxing for a capacity factor (a supply solvent / light lubricating oil fraction) preferably. although there is especially no limit as temperature of extract processing in that case -- the temperature of the solvent at the time of an extract -- usually -40- it is suitable to carry out -10 degrees C preferably, so that it may be held in the range of -40--15 degree C. Extract removal of the part for a wax is carried out from said light lubricating oil fraction as mentioned above, it dissociates with a solvent and the light lubricating oil fractions which removed a part for a wax are collected. In addition, in order to fully remove a part for a wax, it is desirable to carry out so that it may usually become 75 - 93% of the weight of the range to the raw material light lubricating oil fraction which the yield of a recovery light lubricating oil fraction used.

[0029] (b) Dewax under existence of a suitable catalyst by the hydrogenation dewaxing process this gentleman method by carrying out catalytic reaction of said light lubricating oil fraction to hydrogen. Although this hydrogenation dewaxing can also be fundamentally performed according



to a conventional method, can usually make suitably by performing the hydrogenation reaction for dewaxing under the following terms and conditions.

[0030] As a catalyst, although various kinds of things are usable, the zeolite of ZSM-5 or ZSM-5 mold is usually used suitably. G and 20-100kg/cm<sup>2</sup> of selecting 25-70kg/cm<sup>2</sup> of total pressure of a reaction in the range of G preferably are usually appropriate. It is usually suitable for reaction temperature preferably to select [ 230-360-degree C ] in the range of 250-350 degrees C.

[0031] Liquid space velocity (LHSV) is supply oil (light lubricating oil fraction) criteria, and it is usually appropriate for it preferably 0.3-3.0hr<sup>-1</sup> and to select in the range of 0.5-2.5hr<sup>-1</sup>. Vapor liquid separation of the product is carried out after a reaction, and the light lubricating oil fractions by which the request was dewaxed are collected by performing after treatment, such as distillation or solvent extraction, if needed further. However, the method supplied to the following hydrogen-treating process as it is without carrying out vapor liquid separation of the product depending on the case may be adopted.

[0032] (Process 4) Hydrogen treating (dearomatic series processing)

At this process 4, the hydrogen treating of the dewaxing light lubricating oil fraction obtained at the above-mentioned process 3 is carried out under existence of a predetermined hydrogen-treating catalyst, and the purification light lubricating oil fraction by which the aromatic compound contained in this raw material light lubricating oil fraction was hydrogenated, and a part for aromatic series was reduced below at the predetermined value is obtained.

[0033] The hydrogenation catalyst which makes a silica, an alumina, or a silica alumina support, and contains a periodic table VIA group's metal and/or a VIII group's metal as a catalyst used for this hydrogen-treating reaction is used. Here, as a periodic table VI group's metal, Cr, Mo, and W can be mentioned and Mo and W are usually desirable also in these. As a periodic table VIII group's metal, although Fe, Co, nickel, Rh, Ru, Pd, Os, Ir, and Pt can be mentioned, nickel is usually desirable. Although these metals can be used by kind independent and can also be used combining two or more sorts according to a case, combination, such as nickel-Mo and nickel-W, is usually suitable for them. In addition, the support of two or more classes may be used suitably, mixing or compound-izing. Also although various kinds of well-known things can be applied as this catalyst and support component metallurgy group components other than the above are contained, it is usable suitably.

[0034] It is characterized by performing the hydrogen treating for this dearomatic series under high pressure rather than the conventional case, and it is important to carry out under the following terms and conditions. That is, this hydrogen treating is total pressure about reaction pressure, it is important to carry out by selecting 170-230kg/cm<sup>2</sup> in the range of G, and it is especially desirable to select in the range of G and to carry out 180-220kg/cm<sup>2</sup>.

[0035] Here, since sufficient dearomatization does not accomplish that 170kg/cm<sup>2</sup> of reaction pressure is under G, the purpose of this invention cannot fully be attained. Since 230kg/cm<sup>2</sup> of special equipment which bears high pressure so much as it is high pressure is needed from G and facility cost becomes high on the other hand, it is uneconomical. Thus, sufficient dearomatic series becomes possible, without pretreating solvent refining by the furfural of a raw material light lubricating oil fraction which was conventionally performed by reacting in the high-pressure range rather than a conventional method as mentioned above etc. (preceding paragraph dearomatic series processing). Therefore, by the approach of this invention, the part process is simplified and it becomes remarkably [ that it is economical and ] advantageous.

[0036] in addition, the rate of the supply hydrogen gas in this hydrogen treating -- 1kl of supply oils -- receiving -- usually -- 250-1500Nm<sup>3</sup> -- desirable -- 300-1200Nm<sup>3</sup> Adjusting to the range is appropriate. As for reaction temperature, it is important to select in the range of 220-370 degrees C, and it is desirable to select especially in the range which is 230-360 degrees C. If reaction temperature becomes insufficient [ less than 220 degrees C / dearomatic series ] and exceeds 370 degrees C on the other hand, it will become impossible to disregard side reaction, such as a hydrocracking reaction, the yield of a desired lubricating oil fraction will fall, and the disadvantage on a process will be caused.

[0037] moreover, this hydrogen-treating reaction -- liquid space velocity (LHSV) -- supply oil

criteria -- it is -- 0.2-1.5 -- preferably, it adjusts suitably in the range of 0.3-0.8hr<sup>-1</sup>, and carries out in it. Less than [ 0.2hr<sup>-1</sup> ], if productivity worsens and LHSV exceeds 1.5hr<sup>-1</sup> on the other hand, it cannot attain sufficient dearomatization. The generation oil obtained by the hydrogen treating as mentioned above is sent to the following distillation process, and distillation separation is carried out.

[0038] (Process 5) Distillation (recovery of low aromatic series light lubricating oil base oil made into the purpose)

At this process 5, the generation oil obtained by the hydrogen treating of the above-mentioned process 4 is distilled, and the light lubricating oil base oil made into the purpose is obtained. Although this distillation can be performed according to a conventional method, a boiling range carries out separation recovery of the 250-430 degrees C of the lubricating oil base oil made into the purpose as a 260-420-degree C fraction preferably. In addition, when presenting said dewaxing process with the mixture of Fraction III and Fraction II, heavy lubricating oil base oil can be separated into coincidence from the light lubricating oil base oil of this invention by this distillation.

[0039] It is cheap, and according to the above processes 1-5, from the low heavy gas oil of added value, a vacuum gas oil, or its mixture, it is efficient and, moreover, that of the light lubricating oil base oil of this invention which satisfies the conditions of the aforementioned \*\* - \*\* can be manufactured with sufficient productivity by low cost. In this way, the obtained lubricating oil base oil can be used in favor of various kinds of above mentioned applications.

[0040]

[Example] Next, although an example explains this invention concretely, it is not restricted to these examples at all.

[an example 1] -- the bottom of existence of the catalyst system which contains nickel and molybdenum in alumina support, using the heavy gas oil and the mixed oil of a vacuum gas oil which are shown in Table 1 as stock oil, and the catalyst system which contains nickel and molybdenum in an alumina +Y mold zeolite -- the total pressure of 160kg/cm<sup>2</sup>, the reaction temperature of 380 degrees C, LHSV1.0hr<sup>-1</sup>, and hydrogen / oil ratio -- 1000Nm of hydrocracking was performed by 3/kl.

[0041] Atmospheric distillation of the decomposition generation oil was carried out, and 60 % of the weight (390 degrees C of terminal points of the boiling point) and Fraction II were obtained for Fraction I, respectively 40% of the weight (a boiling range is 320-530 degrees C). Next, 60 % of the weight of light fractions and 40 % of the weight (Fraction III, 270-380 degrees C of boiling ranges) of heavy fractions were further obtained by distillation in Fraction I, respectively. this fraction III -- MEK / toluene capacity factor (5/5) partially aromatic solvent -- using -- a solvent / oil ratio -- solvent dewaxing was performed on conditions with 3 times and a filtration temperature of -30 degrees C. Dewaxing yield was 86 capacity %.

[0042] The viscosity index of the kinematic viscosity of this dewaxed oil was 104 in 6.3mm<sup>2</sup> / s (40 degrees C). The pour point at this time was -25.0 degrees C. next, the alumina catalyst with which nickel and a tungsten were supported in dewaxed oil -- using -- the reaction temperature of 290 degrees C, total pressure 210 kg/cm<sup>2</sup> G, LHSV0.5hr<sup>-1</sup>, and hydrogen / oil ratio -- 360Nm of hydrogen treatings was performed by 3/kl.

[0043] Subsequently, the light lubricating oil base oil of 310-380 degrees-C fraction of boiling ranges was obtained for the hydrogen-treating generation oil by distillation. The yield of this base oil was 55 % of the weight to dewaxed oil. As this base oil is shown in Table 2, the amount of aromatic series is as low as 0.6 % of the weight, oxidation stability (RBOT: 0.5 % of the weight addition of additives) is as long as 408 minutes, and the heat instability test is passed further easily. Moreover, the viscosity index of kinematic viscosity was 104 in 8.18mm<sup>2</sup> / s (40 degrees C). The pour point at this time was -25.0 degrees C. Thus, since the amount of aromatic series is low, a weathering test is also passed easily.

[0044] [an example 2] -- 35 % of the weight of fractions III and 65 % of the weight of fractions II distilled and obtained in the example 1 after hydrocracking -- mixing -- this mixed fraction -- MEK / toluene capacity factor (5/5) partially aromatic solvent -- using -- a solvent / oil ratio -- solvent dewaxing was performed on conditions with 3 times and a filtration temperature of -30

degrees C. Dewaxing yield was 78 % of the weight. The viscosity index of the kinematic viscosity of this dewaxed oil was 113 in 14.6mm<sup>2</sup> / s (40 degrees C). The pour point at this time was -22.5 degrees C. next, the alumina catalyst with which nickel and a tungsten were supported in dewaxed oil -- using -- the reaction temperature of 290 degrees C, total pressure 210 kg/cm<sup>2</sup> G, LHSV0.5hr-1, and hydrogen / oil ratio -- 360Nm of hydrogen treatings was performed by 3/kl.

[0045] Subsequently, the hydrogen-treating generation oil was obtained by distillation, and kinematic viscosity obtained 8.13mm<sup>2</sup> / s (40 degrees C), and the light lubricating oil base oil of hypoviscosity this invention at 280-415 degrees C of boiling ranges. The yield of this lubricating oil base oil was 59 % of the weight to dewaxed oil. As this base oil is shown in Table 2, the amount of aromatic series is as low as 0.8 % of the weight, oxidation stability (RBOT: 0.5 % of the weight addition of additives) is as long as 411 minutes, and the heat instability test is passed further easily. Moreover, the pour point of the viscosity index at this time was -25.0 degrees C in 100. Thus, since the amount of aromatic series is low enough, a weathering test is also passed easily. Moreover, kinematic viscosity obtained the heavy lubricating oil base oil of 20.2mm<sup>2</sup> / s (40 degrees C) to coincidence at 300-480 degrees C of boiling ranges. The yield of this base oil was 14 % of the weight to dewaxed oil. The amount of aromatic series of this base oil is as low as 0.6 % of the weight, oxidation stability (RBOT: 0.5 % of the weight addition of additives) is as long as 430 minutes, and the heat instability test is passed further easily. Moreover, the pour point of the viscosity index at this time was -22.5 degrees C in 116.

[an example 3] -- 25 % of the weight of fractions III and 75 % of the weight of fractions II distilled and obtained in the example 1 after hydrocracking -- mixing -- this mixed fraction -- MEK / toluene capacity factor (5/5) partially aromatic solvent -- using -- a solvent / oil ratio -- solvent dewaxing was performed on conditions with 3 times and a filtration temperature of -30 degrees C. Dewaxing yield was 76 % of the weight.

[0046] The viscosity index of the kinematic viscosity of this dewaxed oil was 115 in 16.7mm<sup>2</sup> / s (40 degrees C). The pour point at this time was -22.5 degrees C. next, the alumina catalyst with which nickel and a tungsten were supported in dewaxed oil -- using -- the reaction temperature of 290 degrees C, total pressure 210 kg/cm<sup>2</sup> G, LHSV0.5hr-1, and hydrogen / oil ratio -- 360Nm of hydrogen treatings was performed by 3/kl.

[0047] Subsequently, the hydrogen-treating generation oil was obtained by distillation, and kinematic viscosity obtained 8.10mm<sup>2</sup> / s (40 degrees C), and the light lubricating oil base oil of hypoviscosity this invention at 280-415 degrees C of boiling ranges. The yield of this lubricating oil base oil was 46 % of the weight to dewaxed oil. As this base oil is shown in Table 2, the amount of aromatic series is as low as 1.0 % of the weight, oxidation stability (RBOT: 0.5 % of the weight addition of additives) is as long as 361 minutes, and the heat instability test is passed further easily. Moreover, the pour point of the viscosity index at this time was -25.0 degrees C in 102. Thus, since the amount of aromatic series is low enough, a weathering test is also passed easily. Moreover, kinematic viscosity obtained the heavy lubricating oil base oil of 20.5mm<sup>2</sup> / s (40 degrees C) to coincidence at 340-500 degrees C of boiling ranges. The yield of this base oil was 28 % of the weight to dewaxed oil. The amount of aromatic series of this base oil is as low as 0.8 % of the weight, oxidation stability (RBOT: 0.5 % of the weight addition of additives) is as long as 435 minutes, and the heat instability test is passed further easily. Moreover, the pour point of the viscosity index at this time was -22.5 degrees C in 115.

[0048] [the example 1 of a comparison] -- the process and conditions as an example 1 with same hydrocracking and distillation dewaxing -- carrying out -- the total pressure of hydrogen-treating conditions -- 160 kg/cm<sup>2</sup> G, the reaction temperature of 290 degrees C, LHSV0.5hr-1, and hydrogen / oil ratio -- the hydrogen treating of the 360Nm was carried out by 3/kl, and, subsequently the light lubricating oil base oil of a boiling range 307 - 383-degree-C fraction was obtained for the hydrogenation generation oil by distillation. The yield of this base oil was 56 % of the weight to dewaxed oil. As this base oil is shown in Table 3, the amount of all aromatic series is 4.5 % of the weight, oxidation stability (RBOT: 0.5 % of the weight addition of additives) is 390 minutes, and the heat instability test passes. Moreover, the pour point of the viscosity index at this time was -25.0 degrees C in 104. The weathering test became a rejection.

[0049] [Example 2 of a comparison] It carried out on the process and conditions as an example 1 with same hydrocracking, distillation, and dewaxing, furfural solvent refining of the obtained dewaxed oil was carried out, and the light lubricating oil base oil of a boiling range 310 – 396-degree-C fraction was obtained. The yield (rate of furfural extraction) of this base oil was 72 % of the weight. As this base oil is shown in Table 3, the amount of all aromatic series is 9.6 % of the weight, oxidation stability (RBOT: 0.5 % of the weight addition of additives) is 340 minutes, and the heat instability test passes. Moreover, the pour point of the viscosity index at this time was -25.0 degrees C in 105. The weathering test became a rejection.

[0050]

[Table 1]

原料油	重質軽油	減圧軽油
密度、g/cm <sup>3</sup> @ 15℃	0. 8 7 9	0. 9 1 3
動粘度、mm <sup>2</sup> /s @ 50℃	1 0. 5	2 9. 9
硫黄分、重量%	1. 0	2. 0
窒素分、重量 ppm	3 5 0	7 0 0
残留性状、℃ ASTM D2887		
IBP	238	261
10%	344	376
30%	378	432
50%	396	465
70%	417	493
90%	445	526
EP	506	561

[0051]

[Table 2]

	実施例1	実施例2	実施例3
原料	HGO/VGO	HGO/VGO	HGO/VGO
原料比率 (重量)	5/5	5/5	5/5
水素化分解			
全圧力 $\text{kg/cm}^2 \text{ G}$	160	160	160
温度 $^{\circ}\text{C}$	380	380	380
LHSV $\text{hr}^{-1}$	1.0	1.0	1.0
水素/油比 $\text{Nm}^3/\text{k l}$	1000	1000	1000
溶剤脱ろう			
溶剤/油 容量比	3	3	3
温度 $^{\circ}\text{C}$	-30	-30	-30
水素化			
全圧力 $\text{kg/cm}^2 \text{ G}$	210	210	210
温度 $^{\circ}\text{C}$	290	290	290
LHSV $\text{hr}^{-1}$	0.5	0.5	0.5
水素/油比 $\text{Nm}^3/\text{k l}$	360	360	360
生成基油の物性			
粘度 $\text{mm}^2/\text{s} (@40^{\circ}\text{C})$	8.179	8.128	8.101
粘度指数	104	100	102
流動点 $^{\circ}\text{C}$	-25.0	-25.0	-25.0
引火点 $^{\circ}\text{C}$	186	172	172
アニリン点 $^{\circ}\text{C}$	103.8	101.8	101.3
硫黄分 重量ppm	1以下	1以下	1以下
芳香族分 重量%	0.6	0.8	1.0
熱安定性試験 (判定) *1)	合格	合格	合格
酸化安定性試験 *2) min.	408	411	361
耐候性試験 (判定) *3)	合格 (○)	合格 (○)	合格 (○)

\*1) JIS K It is based on 2540 (evaluation 12 hours after 170 degree-Cx).

\*2) ASTM D It is based on 2272 (0.5 % of the weight addition of additives).

\*3) Evaluation 96 hours after being based on the photodegradation accelerated test equipment indicated by JP,1-94241,A. O showed by considering the case where the sample oil after examining all is transparence as success, and when it was alike to that extent, there was cloudiness more and there were \*\* and settlings, x showed the rejection.

[0052]

[Table 3]

	比較例1	比較例2
原料	HGO/VGO	HGO/VGO
原料比率 (重量)	5/5	5/5
水素化分解		
全圧力 $\text{kg/cm}^2 \text{ G}$	160	160
温度 $^{\circ}\text{C}$	380	380
LHSV $\text{h r}^{-1}$	1.0	1.0
水素/油比 $\text{Nm}^3/\text{k l}$	1000	1000
溶剤脱ろう		
溶剤/油 容量比	3	3
温度 $^{\circ}\text{C}$	-30	-30
水素化		
全圧力 $\text{kg/cm}^2 \text{ G}$	160	-
温度 $^{\circ}\text{C}$	290	-
LHSV $\text{h r}^{-1}$	0.5	-
水素/油比 $\text{Nm}^3/\text{k l}$	360	-
溶剤精製 (フルフラール)		
溶剤/油 容量比	-	4
温度 $^{\circ}\text{C}$	-	60
生成基油の物性		
粘度 $\text{mm}^2/\text{s}$ (@40 $^{\circ}\text{C}$ )	8.185	9.231
粘度指数	104	105
流動点 $^{\circ}\text{C}$	-25.0	-25.0
引火点 $^{\circ}\text{C}$	182	193
アニリン点 $^{\circ}\text{C}$	102.1	101.8
硫黄分 重量ppm	1以下	34
芳香族分 重量%	4.5	9.6
熱安定性試験 (判定) <sup>*1)</sup>	合格	合格
酸化安定性試験 <sup>*2)</sup> min.	390	340
耐候性試験 (判定) <sup>*3)</sup>	不合格 ( $\Delta$ )	不合格 ( $\times$ )

\* 1, \*2, and \*3 are the same as Table 2.

[0053]

[Effect of the Invention] According to this invention, provide the suitable radical genuine article nature as lubricating oil base oil, and it has a viscosity index high moreover enough. And by an aromatic series content's being highly efficient light lubricating oil base oil which has ideal physical properties and description, such as excelling in stability (heat, light, oxidation, shear stability, etc.) etc. very low, and applying this as base oil Expansion of an application temperature requirement, improvement in stability and endurance, and the physical properties as various lubricating oils and optimization of the engine performance can be attained easily. Therefore, for example, various kinds of lubricating oils used for various kinds of industrial machines and equipments, such as automobiles, a vessel, or a machine for construction / machining, etc. for the various purpose The practically remarkable lubricating oil of a useful low aromatic hydrocarbon system which can be advantageously used for (for example, \*\*, such as engine oil, an ATF oil, and hydraulic oil) as the principal component can be offered. Moreover, according to this invention, the approach for it being cheap, being efficient from heavy gas oil with bad description and low added value, a vacuum gas oil, or its mixture, and moreover manufacturing the highly efficient light lubricating oil base oil of above-mentioned this invention with sufficient productivity by low cost can be offered.

[Translation done.]

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TECHNICAL FIELD

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[Field of the Invention] This invention relates to the light lubricating oil base oil advantageously used for various kinds of lubricating oils (\*\*, such as engine oil, an ATF oil, and various hydraulic oil) used for various kinds of industrial machines and equipments, such as automobiles, vessels, or a machine for construction / machining, etc. for the various purpose as base oil used as the principal component, and its manufacture approach.

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PRIOR ART

[Description of the Prior Art] In recent years, high-performance-izing of an automobile, an industrial machine, etc. and energy-saving correspondence progress, and improvement in the engine performance of the lubricating oil used for them is called for strongly. The engine performance of a lubricating oil has the large place which depends on the quality of the base oil used as the principal component, i.e., lubricating oil base oil, especially, in the lubricating oils for automobiles (engine oil, an ATF oil, hydraulic oil, etc.), the hydraulic oil of the machinery for construction / machining, etc., it excels in improvement in shear stability, expansion of an application temperature requirement, oxidation, or the stability over heat and light, and, moreover, lubricating oil base oil of the hydrocarbon system of high performance also with few evaporation losses is moderately desired by hypoviscosity.

[0003] In addition, as a cure of expansion of an application temperature requirement, it is desirable to make high the viscosity index of lubricating oil base oil, and let it be a good plan to make especially the improvement or the reservation of stability to oxidation, heat, light, etc. reduce an aromatic series content. From the former, the approach by solvent extraction, i.e., a solvent refining process, was used widely, and if manufacturing the lubricating oil base oil of a hyperviscous characteristic according to this solvent refining process was also performed for many years, it came for manufacture of the lubricating oil base oil of a hydrocarbon system. However, when manufacturing lubricating oil base oil according to such a solvent refining process, generally it is not easy to raise the viscosity index of a lubricating oil fraction greatly. Therefore, the class of a crude oil itself will be limited narrowly, and moreover, even if strict in the extraction condition, since an improvement and control of oxidation stability etc. of other physical properties were also difficult, fully attaining hyperviscous indexation had easily, the trouble of receiving a limit strong against the physical properties and application of a product.

[0004] Then, as a means to manufacture the lubricating oil base oil of a hyperviscous characteristic, the approach of combining a solvent refining process and/or hydrotreating with hydrocracking is proposed, and the attempt which is going to raise hyperviscous indexation and coincidence also as for the stability over heat, oxidation, etc. is comparatively made recently by reducing or controlling a part for aromatic series by solvent refining and/or the hydrogen treating in that case. (Refer to JP,3-223393,A, a 4-36391 official report, a 6-116570 official report, a 6-116571 official report, and a 6-116572 official report) . However, since it is hard to reduce an aromatic series content efficiently in any case, even if satisfied with an approach given in the above-mentioned official report of hyperviscous indexation, there will be a problem that the reservation of stability to oxidation, heat, light, etc. is not easy.

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## EFFECT OF THE INVENTION

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[Effect of the Invention] According to this invention, provide the suitable radical genuine article nature as lubricating oil base oil, and it has a viscosity index high moreover enough. And by an aromatic series content's being highly efficient light lubricating oil base oil which has ideal physical properties and description, such as excelling in stability (heat, light, oxidation, shear stability, etc.) etc. very low, and applying this as base oil Expansion of an application temperature requirement, improvement in stability and endurance, and the physical properties as various lubricating oils and optimization of the engine performance can be attained easily. Therefore, for example, various kinds of lubricating oils used for various kinds of industrial machines and equipments, such as automobiles, a vessel, or a machine for construction / machining, etc. for the various purpose The practically remarkable lubricating oil of a useful low aromatic hydrocarbon system which can be advantageously used for (for example, \*\*, such as engine oil, an ATF oil, and hydraulic oil) as the principal component can be offered. Moreover, according to this invention, the approach for it being cheap, being efficient from heavy gas oil with bad description and low added value, a vacuum gas oil, or its mixture, and moreover manufacturing the highly efficient light lubricating oil base oil of above-mentioned this invention with sufficient productivity by low cost can be offered.

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**TECHNICAL PROBLEM**

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[Problem(s) to be Solved by the Invention] When it was made from the above-mentioned viewpoint, and it has a viscosity index high enough, and an aromatic series content is light lubricating oil base oil which was low excellent in stability (heat, light, oxidation, shear stability, etc.) etc. and uses this as base oil, this invention Expansion of an application temperature requirement, improvement in stability and endurance, and the physical properties as a lubricating oil and optimization of the engine performance can be attained easily. For example, the light lubricating oil base oil which can be advantageously used as base oil of various kinds of lubricating oils used for industrial machines and equipments, such as automobiles, a vessel, or a machine for construction / machining, It aims at offering the manufacture approach of light lubricating oil base oil that the light lubricating oil base oil of this high performance can be obtained comparatively easily at low cost from heavy gas oil or a vacuum gas oil.

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MEANS

[Means for Solving the Problem] this invention person etc. completes a header and this invention for the approach the light lubricating oil base oil which has specific physical properties and description as a result of research consists of new technique of carrying out a hydrogen treating on condition that specification wholeheartedly as the manufacture approach of becoming the outstanding light lubricating oil base oil with which are satisfied of the above-mentioned purpose, and the light lubricating oil base oil made into the purpose of such high performance being an advantageous approach suitably and practical.

[0007] Namely, this invention is in within the limits whose boiling point in \*\* ordinary pressure it is light lubricating oil base oil of a hydrocarbon system, and is 250-430 degrees C. \*\* The amount of all aromatic series is 1.8 or less % of the weight, and the kinematic viscosity in \*\*40 degree C is in the range of 5-10mm<sup>2</sup> / s. \*\* A viscosity index is 95 or more and \*\* pour point is -10 degrees C or less. \*\* Offer the light lubricating oil base oil characterized by the oxidation stability when adding 2 and 6-JITA challis butyl-p-cresol (DBPC) 0.5% of the weight being 340 minutes or more in a RBOT value.

[0008] moreover, this invention as the suitable manufacture approach of the light lubricating oil base oil of above-mentioned this invention Heavy gas oil (HGO) and/or a vacuum gas oil (VGO) are hydrocracked. Distillation separation of the decomposition product concerned is carried out at the fraction (fraction I) whose terminal point of the boiling point is 250-390 degrees C, and the fraction (fraction II) whose boiling range is 250-540 degrees C. Furthermore, distill the fraction I concerned and separation recovery of the fraction (fraction III) whose boiling range is 240-390 degrees C is carried out. the mixture of Fraction III or Fraction III, and Fraction II concerned being boiled, dewaxing processing being performed, and a part for a wax being removed from this fraction, and the obtained fraction which was dewaxed under existence of a hydrogenation catalyst The total pressure of 170-230kg/cm<sup>2</sup> G, the reaction temperature of 220-370 degrees C, A hydrogen treating is carried out on condition that supply liquid-space-velocity (LHSV) 0.2-1.5hr<sup>-1</sup>, and the approach characterized by carrying out separation recovery of the fraction which is in within the limits whose boiling point in ordinary pressure is 250-430 degrees C by distillation is collectively offered from this generation oil.

[0009]

[Embodiment of the Invention] Below, the gestalt of operation of this invention is explained. First, the light lubricating oil base oil of this invention is explained. although the light lubricating oil base oil of this invention is realizable as a thing of various presentations or description according to the purpose and the manufacture approach -- at least -- the conditions of the aforementioned \*\* - \*\* -- it is important that it is all satisfied.

[0010] That is, it is important for the light lubricating oil base oil of this invention that it is in within the limits whose boiling point in ordinary pressure is 250-430 degrees C, its 290-390 degrees C are desirable, and its 300-380 degrees C are still more desirable. If the boiling point contains the fraction of a high-boiling point remarkably exceeding the low-boiling point of less than 250 degrees C, or 430 degrees C, the basic property as lubricating oil base oil may not be demonstrated enough, for example, an evaporation loss will increase or it will be easy to produce trouble, such as becoming an increase of energy loss by viscous drag size, here.

[0011] Although it is hydrocarbon mixture which is the thing of a hydrocarbon system and generally uses saturated hydrocarbon, such as n-paraffin, a branched paraffin, and a naphthene hydrocarbon, as a principal component, though the light lubricating oil base oil of this invention contains aromatic hydrocarbon, it is important also for the amount of all aromatic series being 1.8 or less % of the weight, and that [ its ] the amount of [ whose ] all aromatic series is 1.2 or less % of the weight especially is desirable. The value for all aromatic series here is measured by the approach of ASTM-D -2549 (following, the same). Thus, by carrying out a total aromatic series content to 1.8 or less % of the weight, the stability over heat, light, oxidation, etc. is fully securable, it is fully stable and the lubricating oil excellent in endurance can be realized easily.

[0012] Moreover, as for the light lubricating oil base oil of this invention, it is also important that the kinematic viscosity in 40 degrees C is in the range of 5-10mm<sup>2</sup> / s, and what is in the range of 6-9mm<sup>2</sup> / s especially is desirable. That is, the light lubricating oil base oil of this invention is characterized by having an above comparatively low kinematic viscosity property, and is hypoviscosity lubricating oil base oil of high performance. Moreover, the light lubricating oil base oil of this invention is important also for a viscosity index being 95 or more, and it is desirable that it is 98 or more especially. Since the viscosity index has the high value or more of 95 in this way, by applying this as base oil of a lubricating oil, the light lubricating oil base oil of this invention can fully expand the application temperature requirement of the lubricating oil, and can attain multi-clade-ization of a lubricating oil suitably. Also in the case of the light lubricating oil base oil of this invention, the additive for improving a viscosity index can also be used, adding to it suitably, but in the case of this invention, since it may be few, an additive has the advantage that the fall (for example, fall of shear stability) of the other physical properties and property which tend to be produced by addition of an additive can be controlled to the minimum. In addition, the light lubricating oil base oil of this invention possesses high shear stability.

[0013] Furthermore, the light lubricating oil base oil of this invention is important also for the pour point being -10.0 degrees C or less, and what is -15.0 degrees C or less especially is desirable. By this, the cold-temperature fluidity of a lubricating oil can be secured and it can fully respond also to the use in a low-temperature environment. Moreover, although the light lubricating oil base oil of this invention has the stability over heat sufficient also by itself, light, oxidation, etc., various kinds of stabilizers, stabilization assistants, etc., such as an oxidation stabilizer, can be added and used for it if needed. As this oxidation stabilizer, although various kinds of well-known things, such as the below-mentioned thing, are usable, it is important for the light lubricating oil base oil of this invention that the oxidation stability when adding 2 and 6-JITA challis butyl-p-cresol (DBPC) 0.5% of the weight is also 340 minutes or more in a RBOT value (in addition, a RBOT value is measured by ASTM-D -2272 in this case). Of course, this does not mean always adding and using DBPC, can show that it is said that oxidation stability high enough is very securable as mentioned above with addition of the oxidation stabilizer of a minute amount, and can add and use the oxidation stabilizer of arbitration at a rate of arbitration if needed.

[0014] If the light lubricating oil base oil of this invention has satisfied the conditions of the above-mentioned \*\* - \*\* at least as mentioned above, although there is especially no limit about general physical properties, descriptions, etc. other than these, what is generally in the range whose aniline point is 95-110 degrees C is desirable, and a thing 150 degrees C or more is desirable about the flash point, and, speaking of a hue, +20 or more things are desirable in for example, a Saybolt color.

[0015] As mentioned above, the light lubricating oil base oil of this invention is excellent in the radical genuine article nature as lubricating oil base oil for preparing the lubricating oil of various kinds of high performance. It has a hyperviscous characteristic especially. Also in itself, the amount of aromatic series few enough Heat, It is hypoviscosity light lubricating oil base oil of the high performance which has the various advantages of fully being able to attain the further improvement in the stability over light, oxidation, etc. It can be used very advantageous as base oil for preparing the optimal lubricating oil for various kinds of applications by responding to the purpose, adjusting and optimizing the physical properties and description of \*\* - \*\*, or selecting and adjusting other physical properties and descriptions suitably within the limits of the above.

[0016] In addition, it responds to the purpose, and various kinds of additives can be used for the light lubricating oil base oil of this invention, mixing or adding to it. That is, although itself of the light lubricating oil base oil of this invention is also usable as a lubricating oil, it is good to use it as a lubricating oil which added various kinds of following additives according to the purpose, and usually suited each application. As an additive, various kinds of things, such as a well-known thing, are usable. For example, phenol systems, such as 2 and 6-JITA chalis butyl-p-cresol, Antioxidants, such as an amine system, a sulfur system, a thiophosphoric acid zinc system, and a phenothiazin system, Molybdenum dithiophosphate, a molybdenum dithio carbamate, molybdenum disulfide, Fluoride carbon, way acid ester, fatty amine, higher alcohol, Friction reduction agents, such as a higher fatty acid, fatty acid ester, and a fatty-acid amide, tricresyl phosphate, Extreme pressure agents, such as triphenyl phosphate and dithiophosphate zinc, petroleum sulfonate, Rust preventives, such as alkylbenzene sulfonate and dinonyl naphthalene sulfonate, Metal deactivators, such as benzotriazol, alkaline-earth-metal sulfonate, Metal system detergent, such as alkali earth metal phenate, an alkaline-earth-metal SARISHI rate, and alkali-metal phosphonate, viscosity index improvers, such as defoaming agents, such as silicone, polymethacrylate, a polyisobutylene, and polystyrene, a pour point depressant, etc. are mentioned, and independent in these -- or two or more sorts can be combined and it can add.

[0017] Next, as the general manufacture approach, although there is no lubricating oil of this invention, it can manufacture especially a limit with suitably and sufficient productivity by the approach of said this invention. Moreover, as for the lubricating oil base oil of this invention, what was manufactured by the approach of this invention is desirable. Hereafter, the approach of this invention which is the suitable manufacture approach of the light lubricating oil base oil of this invention is explained to a detail.

[0018] In the approach of this invention, heavy gas oil (HGO), a vacuum gas oil (VGO), or the mixed oil of the rate of such arbitration is used as stock oil. As this stock oil, the thing from various kinds of crude oils etc. is usable. From this stock oil, target lubricating oil base oil is fundamentally manufactured according to the essential-oil process which becomes order from a hydrocracking process, a distillation process, dewaxing (wax part removal) down stream processing, a hydrogen-treating (dearomatic series) process, and a distillation process, as shown below.

[0019] (Process 1) hydrogenation part \*\* -- as stock oil with which this hydrocracking is presented, fundamentally, although said heavy gas oil (HGO), a vacuum gas oil (VGO), or the mixed oil of the rate of such arbitration is used, optimum dose addition of the recycle oil from a latter process may be carried out suitably, and a reaction may be presented at these if needed.

[0020] Hydrocracking is usually suitably carried out under the terms and conditions shown below. That is, reaction pressure is total pressure and G and 100-190kg/cm<sup>2</sup> of selecting 130-180kg/cm<sup>2</sup> in the range of G are usually suitable for it preferably. the rate of supply hydrogen gas -- 1kl of supply oils -- receiving -- usually -- 500-1500Nm<sup>3</sup> -- desirable -- 800-1200Nm<sup>3</sup> It is good to adjust to the range.

[0021] It is usually suitable for reaction temperature preferably to select [ 340-440-degree C ] in the range of 350-420 degrees C. moreover, liquid space velocity (LHSV) -- supply oil criteria -- it is -- usually -- 0.3-1.5hr<sup>-1</sup> -- what is necessary is just to adjust suitably in the range of 0.5-1.2hr<sup>-1</sup> preferably As a catalyst used for this hydrocracking, a silica alumina, an alumina, and/or a zeolite are made into support, and what supported a periodic table VIA group's metal and/or a VIII group's metal to the support is used. Here, as a periodic table VIA group metal, Cr, Mo, and W can be mentioned and Mo and W are desirable especially. As a periodic table VIII group metal, although Fe, Co, nickel, Rh, Ru, Pd, Os, Ir, and Pt can be mentioned, nickel is usually desirable. Although these metals can also be used by kind independent and it can also be used combining two or more sorts, combination, such as nickel-Mo and nickel-W, is usually suitable.

[0022] In addition, although various kinds of things, such as an X type, Y mold, faujasite, ZSM-5, and mordenite, can be used when using a zeolite, Y mold is used suitably even especially in inside. Moreover, the support of two or more classes may be used suitably, mixing or compounding. For example, in the case of a zeolite, what used the alumina, the silica alumina, etc. as a matrix and fabricated them to this is used suitably. Furthermore, as this catalyst, the

thing containing support component metallurgy group components other than the above is also usable suitably.

[0023] (Process 2) At the process of \*\*\*\*\*, distillation separates the decomposition generation oil obtained by hydrocracking of the above-mentioned process 1 into the fraction (fraction I) whose terminal point of the boiling point is 250-390 degrees C, and the fraction (fraction II) whose boiling range is 250-540 degrees C. The boiling range where Fraction II is desirable is 300-530 degrees C. Subsequently, Fraction I is distilled further and it separates into a fraction lighter than the fraction (fraction III) and Fraction III whose boiling range is 240-390 degrees C. The boiling range where Fraction III is desirable is 270-390 degrees C. In addition, the boiling point of ordinary pressure or ordinary pressure conversion shows each boiling range (following, the same).

[0024] In this way, the mixture (henceforth a light lubricating oil fraction) of separated Fraction III or Fraction III, and Fraction II is sent to the following process 3, and dewaxing processing is presented with it. Here, as for the mixed rate of Fraction III and Fraction II, Fraction III of Fraction II is usually 90 - 10 % of the weight to 10 - 100 % of the weight. In addition, Fraction II may recycle a part at the above-mentioned process 1 if needed. On the other hand, a fraction lighter than the separated fraction II and Fraction III and recovery gas can be used effective in each application. In addition, when using the mixture of Fraction III and Fraction II, it may mix, after performing dewaxing processing of a process 3 separately, and the hydrogen treating of a process 4 may be performed.

[0025] (Process 3) dewaxing \*\*\*\* -- at this process 3, dewaxing processing of the light lubricating oil fraction obtained at the above-mentioned process 2 is carried out, and a part for a wax (a part for a wax) is fully removed. This dewaxing processing is performed with the hydrogenation dewaxing process (b) which hydrogenates using the following solvent dewaxing process (a) or following catalyst by solvent extraction. In addition, if needed, (b) may be combined with (a), and (b) may be suitably, carried out after (a) in that case, or (a) may be conversely performed after (b). However, the following (a) or (b) can usually perform sufficient dewaxing processing.

[0026] (a) MEK usually using a methyl ethyl ketone (MEK) as an extract solvent component although various kinds of well-known solvent dewaxing processes using various kinds of solvents as a solvent dewaxing process of \*\*\*\*\* are applicable -- law is used suitably. Although dewaxing processing by this MEK method can be fundamentally performed according to a conventional method, it is usually suitable to carry out under the following terms and conditions.

[0027] namely, -- as an extract solvent -- from MEK and toluene -- becoming -- MEK -- 30 to 70 capacity % -- desirable -- 35 to 50 capacity % -- it is -- this -- corresponding -- toluene -- 70 to 30 capacity % -- the thing of a presentation of 65 - 50 capacity % is used suitably preferably. In addition, the solvent which carried out optimum dose addition of other solvents other than MEK and toluene suitably may be used if needed.

[0028] As a supply rate of said light lubricating oil fraction with which said extract solvent and dewaxing processing are presented, although there is especially no limit, it is usually suitable 1.0-6.0, and to select in the range of 1.5-4.5, and to carry out extract dewaxing for a capacity factor (a supply solvent / light lubricating oil fraction) preferably. although there is especially no limit as temperature of extract processing in that case -- the temperature of the solvent at the time of an extract -- usually -40- it is suitable to carry out -10 degrees C preferably, so that it may be held in the range of -40--15 degree C. Extract removal of the part for a wax is carried out from said light lubricating oil fraction as mentioned above, it dissociates with a solvent and the light lubricating oil fractions which removed a part for a wax are collected. In addition, in order to fully remove a part for a wax, it is desirable to carry out so that it may usually become 75 - 93% of the weight of the range to the raw material light lubricating oil fraction which the yield of a recovery light lubricating oil fraction used.

[0029] (b) Dewax under existence of a suitable catalyst by the hydrogenation dewaxing process this gentleman method by carrying out catalytic reaction of said light lubricating oil fraction to hydrogen. Although this hydrogenation dewaxing can also be fundamentally performed according



to a conventional method, can usually make suitably by performing the hydrogenation reaction for dewaxing under the following terms and conditions.

[0030] As a catalyst, although various kinds of things are usable, the zeolite of ZSM-5 or ZSM-5 mold is usually used suitably. G and 20-100kg/cm<sup>2</sup> of selecting 25-70kg/cm<sup>2</sup> of total pressure of a reaction in the range of G preferably are usually appropriate. It is usually suitable for reaction temperature preferably to select [ 230-360-degree C ] in the range of 250-350 degrees C.

[0031] Liquid space velocity (LHSV) is supply oil (light lubricating oil fraction) criteria, and it is usually appropriate for it preferably 0.3-3.0hr<sup>-1</sup> and to select in the range of 0.5-2.5hr<sup>-1</sup>. Vapor liquid separation of the product is carried out after a reaction, and the light lubricating oil fractions by which the request was dewaxed are collected by performing after treatment, such as distillation or solvent extraction, if needed further. However, the method supplied to the following hydrogen-treating process as it is without carrying out vapor liquid separation of the product depending on the case may be adopted.

[0032] (Process 4) Hydrogen treating (dearomatic series processing)

At this process 4, the hydrogen treating of the dewaxing light lubricating oil fraction obtained at the above-mentioned process 3 is carried out under existence of a predetermined hydrogen-treating catalyst, and the purification light lubricating oil fraction by which the aromatic compound contained in this raw material light lubricating oil fraction was hydrogenated, and a part for aromatic series was reduced below at the predetermined value is obtained.

[0033] The hydrogenation catalyst which makes a silica, an alumina, or a silica alumina support, and contains a periodic table VIA group's metal and/or a VIII group's metal as a catalyst used for this hydrogen-treating reaction is used. Here, as a periodic table VI group's metal, Cr, Mo, and W can be mentioned and Mo and W are usually desirable also in these. As a periodic table VIII group's metal, although Fe, Co, nickel, Rh, Ru, Pd, Os, Ir, and Pt can be mentioned, nickel is usually desirable. Although these metals can be used by kind independent and can also be used combining two or more sorts according to a case, combination, such as nickel-Mo and nickel-W, is usually suitable for them. In addition, the support of two or more classes may be used suitably, mixing or compound-izing. Also although various kinds of well-known things can be applied as this catalyst and support component metallurgy group components other than the above are contained, it is usable suitably.

[0034] It is characterized by performing the hydrogen treating for this dearomatic series under high pressure rather than the conventional case, and it is important to carry out under the following terms and conditions. That is, this hydrogen treating is total pressure about reaction pressure, it is important to carry out by selecting 170-230kg/cm<sup>2</sup> in the range of G, and it is especially desirable to select in the range of G and to carry out 180-220kg/cm<sup>2</sup>.

[0035] Here, since sufficient dearomatization does not accomplish that 170kg/cm<sup>2</sup> of reaction pressure is under G, the purpose of this invention cannot fully be attained. Since 230kg/cm<sup>2</sup> of special equipment which bears high pressure so much as it is high pressure is needed from G and facility cost becomes high on the other hand, it is uneconomical. Thus, sufficient dearomatic series becomes possible, without pretreating solvent refining by the furfural of a raw material light lubricating oil fraction which was conventionally performed by reacting in the high-pressure range rather than a conventional method as mentioned above etc. (preceding paragraph dearomatic series processing). Therefore, by the approach of this invention, the part process is simplified and it becomes remarkably [ that it is economical and ] advantageous.

[0036] in addition, the rate of the supply hydrogen gas in this hydrogen treating -- 1kl of supply oils -- receiving -- usually -- 250-1500Nm<sup>3</sup> -- desirable -- 300-1200Nm<sup>3</sup> Adjusting to the range is appropriate. As for reaction temperature, it is important to select in the range of 220-370 degrees C, and it is desirable to select especially in the range which is 230-360 degrees C. If reaction temperature becomes insufficient [ less than 220 degrees C / dearomatic series ] and exceeds 370 degrees C on the other hand, it will become impossible to disregard side reaction, such as a hydrocracking reaction, the yield of a desired lubricating oil fraction will fall, and the disadvantage on a process will be caused.

[0037] moreover, this hydrogen-treating reaction -- liquid space velocity (LHSV) -- supply oil

criteria -- it is -- 0.2-1.5 -- preferably, it adjusts suitably in the range of 0.3-0.8hr<sup>-1</sup>, and carries out in it. Less than [ 0.2hr<sup>-1</sup> ], if productivity worsens and LHSV exceeds 1.5hr<sup>-1</sup> on the other hand, it cannot attain sufficient dearomatization. The generation oil obtained by the hydrogen treating as mentioned above is sent to the following distillation process, and distillation separation is carried out.

[0038] (Process 5) Distillation (recovery of low aromatic series light lubricating oil base oil made into the purpose)

At this process 5, the generation oil obtained by the hydrogen treating of the above-mentioned process 4 is distilled, and the light lubricating oil base oil made into the purpose is obtained.

Although this distillation can be performed according to a conventional method, a boiling range carries out separation recovery of the 250-430 degrees C of the lubricating oil base oil made into the purpose as a 260-420-degree C fraction preferably. In addition, when presenting said dewaxing process with the mixture of Fraction III and Fraction II, heavy lubricating oil base oil can be separated into coincidence from the light lubricating oil base oil of this invention by this distillation.

[0039] It is cheap, and according to the above processes 1-5, from the low heavy gas oil of added value, a vacuum gas oil, or its mixture, it is efficient and, moreover, that of the light lubricating oil base oil of this invention which satisfies the conditions of the aforementioned \*\* - \*\* can be manufactured with sufficient productivity by low cost. In this way, the obtained lubricating oil base oil can be used in favor of various kinds of above mentioned applications.

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[Translation done.]

\* NOTICES \*

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1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.\*\*\*\* shows the word which can not be translated.

3.In the drawings, any words are not translated.

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EXAMPLE

[Example] Next, although an example explains this invention concretely, it is not restricted to these examples at all.

[an example 1] -- the bottom of existence of the catalyst system which contains nickel and molybdenum in alumina support, using the heavy gas oil and the mixed oil of a vacuum gas oil which are shown in Table 1 as stock oil, and the catalyst system which contains nickel and molybdenum in an alumina +Y mold zeolite -- the total pressure of 160kg/cm<sup>2</sup>, the reaction temperature of 380 degrees C, LHSV1.0hr<sup>-1</sup>, and hydrogen / oil ratio -- 1000Nm of hydrocracking was performed by 3/kl.

[0041] Atmospheric distillation of the decomposition generation oil was carried out, and 60 % of the weight (390 degrees C of terminal points of the boiling point) and Fraction II were obtained for Fraction I, respectively 40% of the weight (a boiling range is 320-530 degrees C). Next, 60 % of the weight of light fractions and 40 % of the weight (Fraction III, 270-380 degrees C of boiling ranges) of heavy fractions were further obtained by distillation in Fraction I, respectively. this fraction III -- MEK / toluene capacity factor (5/5) partially aromatic solvent -- using -- a solvent / oil ratio -- solvent dewaxing was performed on conditions with 3 times and a filtration temperature of -30 degrees C. Dewaxing yield was 86 capacity %.

[0042] The viscosity index of the kinematic viscosity of this dewaxed oil was 104 in 6.3mm<sup>2</sup> / s (40 degrees C). The pour point at this time was -25.0 degrees C. next, the alumina catalyst with which nickel and a tungsten were supported in dewaxed oil -- using -- the reaction temperature of 290 degrees C, total pressure 210 kg/cm<sup>2</sup> G, LHSV0.5hr<sup>-1</sup>, and hydrogen / oil ratio -- 360Nm of hydrogen treatings was performed by 3/kl.

[0043] Subsequently, the light lubricating oil base oil of 310-380 degrees-C fraction of boiling ranges was obtained for the hydrogen-treating generation oil by distillation. The yield of this base oil was 55 % of the weight to dewaxed oil. As this base oil is shown in Table 2, the amount of aromatic series is as low as 0.6 % of the weight, oxidation stability (RBOT: 0.5 % of the weight addition of additives) is as long as 408 minutes, and the heat instability test is passed further easily. Moreover, the viscosity index of kinematic viscosity was 104 in 8.18mm<sup>2</sup> / s (40 degrees C). The pour point at this time was -25.0 degrees C. Thus, since the amount of aromatic series is low, a weathering test is also passed easily.

[0044] [an example 2] -- 35 % of the weight of fractions III and 65 % of the weight of fractions II distilled and obtained in the example 1 after hydrocracking -- mixing -- this mixed fraction -- MEK / toluene capacity factor (5/5) partially aromatic solvent -- using -- a solvent / oil ratio -- solvent dewaxing was performed on conditions with 3 times and a filtration temperature of -30 degrees C. Dewaxing yield was 78 % of the weight. The viscosity index of the kinematic viscosity of this dewaxed oil was 113 in 14.6mm<sup>2</sup> / s (40 degrees C). The pour point at this time was -22.5 degrees C. next, the alumina catalyst with which nickel and a tungsten were supported in dewaxed oil -- using -- the reaction temperature of 290 degrees C, total pressure 210 kg/cm<sup>2</sup> G, LHSV0.5hr<sup>-1</sup>, and hydrogen / oil ratio -- 360Nm of hydrogen treatings was performed by 3/kl.

[0045] Subsequently, the hydrogen-treating generation oil was obtained by distillation, and kinematic viscosity obtained 8.13mm<sup>2</sup> / s (40 degrees C), and the light lubricating oil base oil of

hypoviscosity this invention at 280–415 degrees C of boiling ranges. The yield of this lubricating oil base oil was 59 % of the weight to dewaxed oil. As this base oil is shown in Table 2, the amount of aromatic series is as low as 0.8 % of the weight, oxidation stability (RBOT: 0.5 % of the weight addition of additives) is as long as 411 minutes, and the heat instability test is passed further easily. Moreover, the pour point of the viscosity index at this time was –25.0 degrees C in 100. Thus, since the amount of aromatic series is low enough, a weathering test is also passed easily. Moreover, kinematic viscosity obtained the heavy lubricating oil base oil of 20.2mm<sup>2</sup> / s (40 degrees C) to coincidence at 300–480 degrees C of boiling ranges. The yield of this base oil was 14 % of the weight to dewaxed oil. The amount of aromatic series of this base oil is as low as 0.6 % of the weight, oxidation stability (RBOT: 0.5 % of the weight addition of additives) is as long as 430 minutes, and the heat instability test is passed further easily. Moreover, the pour point of the viscosity index at this time was –22.5 degrees C in 116.

[an example 3] -- 25 % of the weight of fractions III and 75 % of the weight of fractions II distilled and obtained in the example 1 after hydrocracking -- mixing -- this mixed fraction -- MEK / toluene capacity factor (5/5) partially aromatic solvent -- using -- a solvent / oil ratio -- solvent dewaxing was performed on conditions with 3 times and a filtration temperature of –30 degrees C. Dewaxing yield was 76 % of the weight.

[0046] The viscosity index of the kinematic viscosity of this dewaxed oil was 115 in 16.7mm<sup>2</sup> / s (40 degrees C). The pour point at this time was –22.5 degrees C. next, the alumina catalyst with which nickel and a tungsten were supported in dewaxed oil -- using -- the reaction temperature of 290 degrees C, total pressure 210 kg/cm<sup>2</sup> G, LHSV0.5hr<sup>-1</sup>, and hydrogen / oil ratio -- 360Nm of hydrogen treatings was performed by 3/kl.

[0047] Subsequently, the hydrogen-treating generation oil was obtained by distillation, and kinematic viscosity obtained 8.10mm<sup>2</sup> / s (40 degrees C), and the light lubricating oil base oil of hypoviscosity this invention at 280–415 degrees C of boiling ranges. The yield of this lubricating oil base oil was 46 % of the weight to dewaxed oil. As this base oil is shown in Table 2, the amount of aromatic series is as low as 1.0 % of the weight, oxidation stability (RBOT: 0.5 % of the weight addition of additives) is as long as 361 minutes, and the heat instability test is passed further easily. Moreover, the pour point of the viscosity index at this time was –25.0 degrees C in 102. Thus, since the amount of aromatic series is low enough, a weathering test is also passed easily. Moreover, kinematic viscosity obtained the heavy lubricating oil base oil of 20.5mm<sup>2</sup> / s (40 degrees C) to coincidence at 340–500 degrees C of boiling ranges. The yield of this base oil was 28 % of the weight to dewaxed oil. The amount of aromatic series of this base oil is as low as 0.8 % of the weight, oxidation stability (RBOT: 0.5 % of the weight addition of additives) is as long as 435 minutes, and the heat instability test is passed further easily. Moreover, the pour point of the viscosity index at this time was –22.5 degrees C in 115.

[0048] [the example 1 of a comparison] -- the process and conditions as an example 1 with same hydrocracking and distillation dewaxing -- carrying out -- the total pressure of hydrogen-treating conditions -- 160 kg/cm<sup>2</sup> G, the reaction temperature of 290 degrees C, LHSV0.5hr<sup>-1</sup>, and hydrogen / oil ratio -- the hydrogen treating of the 360Nm was carried out by 3/kl, and, subsequently the light lubricating oil base oil of a boiling range 307 – 383-degree-C fraction was obtained for the hydrogenation generation oil by distillation. The yield of this base oil was 56 % of the weight to dewaxed oil. As this base oil is shown in Table 3, the amount of all aromatic series is 4.5 % of the weight, oxidation stability (RBOT: 0.5 % of the weight addition of additives) is 390 minutes, and the heat instability test passes. Moreover, the pour point of the viscosity index at this time was –25.0 degrees C in 104. The weathering test became a rejection.

[0049] [Example 2 of a comparison] It carried out on the process and conditions as an example 1 with same hydrocracking, distillation, and dewaxing, furfural solvent refining of the obtained dewaxed oil was carried out, and the light lubricating oil base oil of a boiling range 310 – 396-degree-C fraction was obtained. The yield (rate of furfural extraction) of this base oil was 72 % of the weight. As this base oil is shown in Table 3, the amount of all aromatic series is 9.6 % of the weight, oxidation stability (RBOT: 0.5 % of the weight addition of additives) is 340 minutes, and the heat instability test passes. Moreover, the pour point of the viscosity index at this time was –25.0 degrees C in 105. The weathering test became a rejection.

[0050]

[Table 1]

原料油	重質軽油	減圧軽油
密度、 $\text{g}/\text{cm}^3$ @15℃	0.879	0.913
動粘度、 $\text{mm}^2/\text{s}$ @50℃	10.5	29.9
硫黄分、重量%	1.0	2.0
窒素分、重量 ppm	350	700
炭留性状、℃ ASTM D2887		
IBP	239	261
10%	344	376
30%	378	432
50%	396	465
70%	417	493
90%	445	526
EP	506	561

[0051]

[Table 2]

	実施例1	実施例2	実施例3
原料	HGO/VGO	HGO/VGO	HGO/VGO
原料比率 (重量)	5/5	5/5	5/5
水素化分解			
全圧力 $\text{kg}/\text{cm}^2 \text{ G}$	160	160	160
温度 $^{\circ}\text{C}$	380	380	380
LHSV $\text{hr}^{-1}$	1.0	1.0	1.0
水素/油比 $\text{Nm}^3/\text{k l}$	1000	1000	1000
溶剤脱ろう			
溶剤/油 容量比	3	3	3
温度 $^{\circ}\text{C}$	-30	-30	-30
水素化			
全圧力 $\text{kg}/\text{cm}^2 \text{ G}$	210	210	210
温度 $^{\circ}\text{C}$	290	290	290
LHSV $\text{hr}^{-1}$	0.5	0.5	0.5
水素/油比 $\text{Nm}^3/\text{k l}$	360	360	360
生成基油の物性			
粘度 $\text{mm}^2/\text{s}$ (@40℃)	8.179	8.128	8.101
粘度指数	104	100	102
流動点 $^{\circ}\text{C}$	-25.0	-25.0	-25.0
引火点 $^{\circ}\text{C}$	186	172	172
アニリン点 $^{\circ}\text{C}$	103.8	101.8	101.3
硫黄分 重量ppm	1以下	1以下	1以下
芳香族分 重量%	0.6	0.8	1.0
熱安定性試験 (判定) *1)	合格	合格	合格
酸化安定性試験 *2) min.	408	411	361
耐候性試験 (判定) *3)	合格 (○)	合格 (○)	合格 (○)

\*1) JIS K It is based on 2540 (evaluation 12 hours after 170 degree-Cx).

\*2) ASTM D It is based on 2272 (0.5 % of the weight addition of additives).

\*3) Evaluation 96 hours after being based on the photodegradation accelerated test equipment indicated by JP,1-94241,A. O showed by considering the case where the sample oil after

examining all is transparent as success, and when it was alike to that content, there was cloudiness more and there were \*\* and settlings, x showed the rejection.

[0052]

[Table 3]

	比較例 1	比較例 2
原料	HGO/VGO	HGO/VGO
原料比率 (重量)	5/5	5/5
水素化分解		
全圧力 $\text{kg/cm}^2 \text{ G}$	160	160
温度 $^{\circ}\text{C}$	380	380
LHSV $\text{hr}^{-1}$	1.0	1.0
水素/油比 $\text{Nm}^3/\text{kl}$	1000	1000
溶剤脱ろう		
溶剤/油 容量比	3	3
温度 $^{\circ}\text{C}$	-30	-30
水素化		
全圧力 $\text{kg/cm}^2 \text{ G}$	160	-
温度 $^{\circ}\text{C}$	290	-
LHSV $\text{hr}^{-1}$	0.5	-
水素/油比 $\text{Nm}^3/\text{kl}$	360	-
溶剤精製 (フルフラー)		
溶剤/油 容量比	-	4
温度 $^{\circ}\text{C}$	-	60
生成基油の物性		
粘度 $\text{mm}^2/\text{s} (@40^{\circ}\text{C})$	8.185	9.231
粘度指数	104	105
流動点 $^{\circ}\text{C}$	-25.0	-25.0
引火点 $^{\circ}\text{C}$	182	193
アニリン点 $^{\circ}\text{C}$	102.1	101.8
硫黄分 重量ppm	1以下	34
芳香族分 重量%	4.5	9.6
熱安定性試験 (判定) **	合格	合格
酸化安定性試験 ** min.	390	340
耐候性試験 (判定) **	不合格 ( $\Delta$ )	不合格 ( $\times$ )

\* 1, \*2, and \*3 are the same as Table 2.

[Translation done.]